

HYDRAULIC DISC BRAKE DEVICE

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a hydraulic disc brake device, and more particularly to a hydraulic disc brake device used in a brake system of a vehicle.

Description of the Prior Art

Most of the conventional hydraulic disc brake devices utilize the oil cylinder to press the two brake lining shoes against the brake disc from both sides, and the friction force generated between the brake lining shoe and the brake disc stops the vehicle. However, these conventional hydraulic disc brake devices still have the following disadvantages:

The clamping force caused by the oil pressure in the case of an emergency brake is always very great, and the resultant braking force will be excessively large, and thus probably causing a sudden dead lock. As a result, not only will the tire be locked, but also the vehicle will suffer an instant run-out, leading to a skidding or overturning of the vehicle.

The present invention has arisen to mitigate and/or obviate the afore-described disadvantages.

SUMMARY OF THE INVENTION

The primary objective of the present invention is to provide a hydraulic disc brake system that has an antilock effect.

The secondary objective of the present invention is to provide an economical and low cost hydraulic disc brake system for a vehicle, without needing

any precision electronic instruments or electric mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded view of a hydraulic disc brake device in accordance with a first embodiment of the present invention;

5 Fig. 2 is an assembly cross sectional view of the hydraulic disc brake device in accordance with the first embodiment of the present invention;

Fig. 3 is another assembly cross sectional view of the hydraulic disc brake device in accordance with the first embodiment of the present invention;

10 Fig. 4 is a first cross section operational view of showing the hydraulic disc brake device in accordance with the first embodiment of the present invention;

Fig. 5 is a second cross section operational view of showing the hydraulic disc brake device in accordance with the first embodiment of the present invention;

Fig. 6 is a third cross section operational view of showing the hydraulic disc brake device in accordance with the first embodiment of the present invention;

15 Fig. 7 is a fourth cross section operational view of showing the hydraulic disc brake device in accordance with the first embodiment of the present invention;

Fig. 8 is an exploded view of a hydraulic disc brake device in accordance with a second embodiment of the present invention;

20 Fig. 9 is a cross section operational view of showing the hydraulic disc brake device in accordance with the second embodiment of the present invention;

Fig. 10 is an exploded view of a hydraulic disc brake device in accordance with a third embodiment of the present invention;

Fig. 11 is a first cross section view in accordance with the third embodiment

of the present invention of showing the status of the hydraulic disc brake device before a brake action;

Fig. 12 is a second cross section view in accordance with the third embodiment of the present invention of showing the status of the hydraulic disc
5 brake device before a brake action;

Fig. 13 is a third cross section view in accordance with the third embodiment of the present invention of showing the status of the hydraulic disc brake device before a brake action;

Fig. 14 is a fourth cross section view in accordance with the third
10 embodiment of the present invention of showing the status of the hydraulic disc brake device before a brake action;

Fig. 15 is a first cross section view in accordance with the third embodiment of the present invention of showing the status of the hydraulic disc brake device during a brake action;

15 Fig. 16 is a second cross section view in accordance with the third embodiment of the present invention of showing the status of the hydraulic disc brake device during a brake action;

Fig. 17 is a third cross section view in accordance with the third
embodiment of the present invention of showing the status of the hydraulic disc
20 brake device during a brake action;

Fig. 18 is a fourth cross section view in accordance with the third embodiment of the present invention of showing the status of the hydraulic disc brake device during a brake action;

Fig. 19 is a first cross sectional view in accordance with the third embodiment of the present invention of showing the antilock action of the hydraulic disc brake device;

Fig. 20 is a second cross sectional view in accordance with the third embodiment of the present invention of showing the antilock action of the hydraulic disc brake device; and

Fig. 21 is a third cross sectional view in accordance with the third embodiment of the present invention of showing the antilock action of the hydraulic disc brake device.

10 DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to Figs. 1-5, a hydraulic disc brake device in accordance with the present invention is installed on a wheel carrier 10 and comprises: a base assembly G, a sliding assembly H, a spring assembly S and a positioning board F. Oil W circulates within the base assembly G.

15 The positioning board F is fixed on the wheel carrier 10 by screws, and is provided with two positioning bolts F1.

The base assembly G is positioned on the wheel carrier 10 by the positioning board F and comprises: a pressing device 20, a first arc-shaped track 30, a second arc-shaped track 40, and a control valve assembly 50.

20 The pressing device 20 includes an oil chamber 21, a piston 22, two oil seals 23, 24, a steel-ball positioning disc 25 and a plurality of steel balls 26. A positioning arm 28 protrudes from a side of the pressing device 20 and is to be positioned on one of the positioning bolts F1 by a positioning sleeve 281. The piston

22 is moveably sealed in the oil chamber 21 by the oil seals 23 and 24. The piston 22 is defined in its outer edge with an engaging groove 221, and the steel-ball positioning disc 25 is formed around its outer periphery with a protrusive engaging edge 251 to be engaged in the engaging groove 221. The plurality of steel balls 26 is positioned between the steel-ball positioning disc 25 and the piston 22. A plurality of through holes 252 is defined in the steel-ball positioning disc 25, and the respective steel balls 26 partially protrude from the through holes 252. An exhaust valve 27 is disposed adjacent to the oil chamber 21.

The first arc-shaped track 30 is located correspondingly to the center of the brake disc 11 and is disposed at a side of the pressing device 20, and an end of the first arc-shaped track 30 is positioned on another one of the positioning bolts F1 by a positioning sleeve 31. The first arc-shaped track 30 is covered with a wear-resistance cover 32.

The second arc-shaped track 40 is located correspondingly to the center of the brake disc 11 and is square in cross section. A hole 41 is defined in the second arc-shaped track 40 and is located along the length thereof, and the second arc-shaped track 40 is located at another side of the pressing device 20 and also covered with a wear-resistance cover 42. A safety oil passage 43 is formed in the bottom of the hole 41 and connected to the oil chamber 21.

The control valve assembly 50 includes a control groove 51, a control rod 52, a relief valve 53, a main passage 54, an auxiliary passage 55 and a pressure relief space 56. The control groove 51 is located adjacent to the oil chamber 21. A guide cover 511 with a central hole 513 and a dust-proof ring 512 is screwed to either side

of the control groove 51. Both ends of the control rod 52 are protruded out of the center hole 513 of the two guide covers 511. The control groove 51 is connected to the oil chamber 21 via the main passage 54 and the pressure relief space 56, and the auxiliary passage 55 is connected to the safety oil passage 43 of the second arc-shaped track 40. A sealing screw 542 cooperating with a sealing ring 541 is disposed opposite the main passage 54. Located opposite the auxiliary passage 55 is an oil feeding hole 551. The relief valve 53 includes a pressure relief steel ball 531, a pin 532 and a spring 533 disposed in the pressure relief space 56, respectively. A sealing screw 57 with a sealing ring 571 is disposed beside the pressure relief space 56. The pin 532 is to be pressed against the spring 533 and the oil pressure of the oil chamber 21. The pressure relief steel ball 531 is located in the control groove 51, and the pin 532 is sealed between the oil chamber 21 and the control groove 51 together with a first sliding bush 534, an oil seal 535, a second sliding bush 536 and an dust-proof cover 537. A plurality of oil seals 521, a first oil ring 522, a second oil ring 523 and a sliding bush 59 are positioned in the mid section of the control groove 51 by a C ring 58. The first and second oil rings 522 and 523 each is formed with an open guiding structure for guiding oil out. The first oil ring 522 is located correspondingly to the main passage 54, and the second oil ring 523 is located correspondingly to the auxiliary passage 55. The control rod 52 is formed with a control passage 524, and an oil seal 526 and a sealing screw 525 are screwed in the end of the control passage 524. A first oil hole 527 and a second oil hole 528 are formed in the control passage 524 and are located correspondingly to the first oil ring 522 and the second oil ring 523, respectively. An annular neck portion 529 is

formed on the control rod 52 and is located correspondingly to the pressure relief space 56. When the pressure relief steel ball 531 moves into the annular neck portion 529, a pressure relief oil space B will appear at another end of the pin 532 opposite the pressure relief steel ball 531.

5 The sliding assembly H is slideably disposed on the first and second arc-shaped track 30 and 40 of the base assembly G and includes a seat 60, a brake lining assembly 70 and a sliding device 80.

 The seat 60 includes a first positioning portion 61 and a second positioning portion 62 located correspondingly to the first and the second arc-shaped tracks 30 and 40 of the base assembly G. A stop portion 63 is formed at the end of the second positioning portion 62. An anti-collision piece 631 is fixed on the stop portion 63 by screws 632. A screw 633 is disposed at the center of the stop portion 63 and the anti-collision piece 631. Formed between the first and second positions 61 and 62 is an elliptical sliding hole 64 for passage of the piston 22 of the pressing device 20 and the flange G1 of the base assembly G. A stepped recess 641 is formed at a side of the elliptical sliding hole 64, and an anti-collision block 642 and a fixing piece 644 are fixed in the stepped recess 641 by screws 643. A brake-mounting portion 65 protrudes from the seat 60 and is located around the elliptical sliding hole 64, so that a brake space 66 is defined between the brake-mounting portion 65 and the elliptical sliding hole 64 for accommodation of the brake disc 11 and the brake lining assembly 70. Screwed on the brake-mounting portion 65 are two brake-lining positioning shafts 651 that are to be inserted in the seat 60 and located at both sides of the elliptical sliding hole 64. The brake-mounting portion 65 is provided with an

engaging rib 652 located in the brake space 66. Two opposite abutting blocks 67 are arranged at a side of the elliptical sliding hole 64, and each of which is provided with an abutting screw 671 and an auditing nut 672. The two abutting blocks 67 are pressed against both ends of the control rod 52.

5 The brake lining assembly 70 includes a front brake lining shoe 71 and a rear brake lining shoe 72 that are inserted on the two brake-lining positioning shafts 651 in a parallel manner, and the brake-lining positioning shafts 651 enables the front brake lining shoe 71 and the rear brake lining shoe 72 to move within the brake space 66. A pressing spring leaf 73 is disposed against a side of the front brake lining shoe 71 and the rear brake lining shoe 72 and is positioned on the engaging rib 652
10 of the brake-mounting portion 65 of the seat 60, thus preventing the front brake lining shoe 71 and the rear brake lining shoe 72 from becoming loose. In addition, the front brake lining shoe 71 is pressed against the steel balls 26 on the steel ball positioning disc 25, and can move smoothly under the aid of the steel balls 26.

15 The sliding device 80 includes inverted U-shaped seats 81, dust-proof frames 82 and wear-resistance pieces 83. The inverted U-shaped seats 81 are fixed on the first and second positioning portions 61 and 62 of the seat 60 by rivets 85. The inverted U-shaped seats 81 are slideably mounted on the first and second arc-shaped tracks 30 and 40. A plurality of cavities 811 with steel balls 812 are
20 formed in the respective inverted U-shaped seats 81, and the steel balls 812 are located between the inverted U-shaped seat 81 and the wear-resistance cover 32 and 42. The respective dust-proof frame 82 is fixed to the inverted U-shaped seat 81 by screws 84, so as to prevent dust from entering the arc-shaped tracks.

The spring assembly S is confined in the hole 41 of the second arc-shaped track 40 by the anti-collision piece 631 and the screw 633 of the sliding assembly H, and includes a safety rod 90, two seal rings 91, a safety spring 92, a support bracket 93, a washer 94 and a return spring 95. One end of the return spring 95 cooperating
5 with the washer 94 and the support bracket 93 is pressed against the bottom of the hole 41 of the second arc-shaped track 40, and another end of the return spring 95 is positioned on the screw 633 of the seat 60. The return spring 95 serves to push against the stop portion 63 of the sliding assembly H. The safety spring 92 is restricted in the support bracket 93 and the return spring 95, and the safety rod 90 is
10 riveted to the support bracket 93. The safety rod 93 and the return spring 95 push the safety rod 90 to move, so as to close the safety oil passage 43 of the second arc-shaped track 40.

As shown in Fig. 4, before braking action is initiated, the brake disc 11 rotates counterclockwise along with the wheel, the front brake lining shoe 71 and the
15 rear brake lining shoe 72 are located at both sides of the brake disc 11 in a pressure free manner. At this moment, since the return spring 95 is biased between the hole 41 of the second arc-shaped track 40 of the base assembly G and the anti-collision piece 631 of the sliding assembly H, the motionless base assembly G enables the sliding
assembly H to be pushed by the return spring 95 to the lowest portion of the
20 arc-shaped track. Accordingly, the two opposite abutting blocks 67 of the sliding assembly H are also located at the lowest portion of the arc-shaped track, and push the lower end of the control rod 52 of the control valve assembly 50 upward. Since the control rod 52 moves with respect to the control groove 51 of the control valve

assembly 50, the control passage 524 of the control rod 52 will be aligned to the first oil hole 527, and the second oil hole 528 and the second oil ring 523 will exactly be aligned to the oil feeding hole 551. As a result, the oil W from the oil feeding hole 551 will flow to the oil chamber 21 via the second oil ring 523, the second oil hole 528, the control passage 524, the first oil hole 527, the first oil ring 522 and the main passage 54. However, before the oil W pressure increases, the piston 22 will not be driven by any oil pressure from the oil chamber 21.

On the other hand, the sliding assembly H doesn't move relative to the base assembly G, therefore, the front surface of the front brake lining shoe 71 is not pressed against the steel balls 26. At this moment, the brake lining assembly 70 doesn't clamp the brake disc 11, and the annular neck portion 529 of the control rod 52 is located below the pressure relief steel ball 531 of the pressure relief valve 53. Therefore, the wheel can rotate freely without any resistance.

When the hydraulic disc brake device is activated at a relatively high speed, as both shown in Figs. 4 and 5, the brake disc 11 still rotates counterclockwise, at this moment, the oil W increases in pressure and flows from the oil feeding hole 551 to the oil chamber 21 via the second oil ring 523, the second oil hole 528, the control passage 524, the first oil hole 527, the first oil ring 522 and the main passage 54 (as indicated by the arrow). Meanwhile, the piston 22 of the pressing assembly 20 is moved by the oil pressure from the oil chamber 21, pushing the front brake lining shoe 71 toward the rear brake lining shoe 72, as a result, the brake disc 11 is clamped firmly by the front and second brake lining shoes 71 and 72, causing an emergency braking action.

After that, as shown in Fig. 5, at the instant the braking action is initiated, the front and second brake lining shoes 71 and 72 absorb a lot of counterclockwise stress from the brake disc 11, generating a very large counterclockwise stress toward the center of the brake disc 11. Since the sliding assembly H is slideably disposed in the first and second arc-shaped tracks 30 and 40 of the base assembly G, the first and second arc-shaped tracks 30 and 40 are located opposite the center of the brake disc 11, plus the inertial force produced by an emergency of a high speed vehicle is larger than the critical value of the elastic force of the return spring 95 of the spring assembly S. The emergency-brake caused stress will push the sliding assembly H to slide counterclockwise while compressing the return spring 95 (as shown in Fig. 5).

At the same time, the counterclockwise motion of the slide assembly H causes a displacement of the slide assembly H relative to the base assembly G, and the abutting blocks 67 of the sliding assembly H push the control rod 52 of the control valve assembly 50 to move, so that the control groove 51 of the control valve assembly 50 changes with the upward movement of the control rod 52, and the first and second oil rings 522 and 523 are not aligned with the main passage 54 and the auxiliary passage 55 anymore. Therefore, the oil W stops flowing into the oil chamber 21. At this moment, the control rod 52 of the control valve assembly 50 moves upward, therefore, the annular neck portion 529 of the control rod 52 moves upward to a position aligned with the pressure relief steel ball 531. Under the effect of the pushing force of the spring 533 and the oil pressure of the oil chamber 21, the pin 532 pushes the pressure relief steel ball 531 into the annular neck portion 529 of the control rod 52, and as a result, a pressure relief oil space B appears at another

end of the pin 532 facing the oil chamber 21. At this moment, the oil W will be decompressed instantly after flowing into the pressure relief oil space B, so that the piston 22 of the pressing device 20 reduces its pushing force on the front brake lining shoe 71, and accordingly, the brake lining assembly 70 relieves its clamping
5 force against the brake disc 11. At this moment, the brake-caused counterclockwise stress disappears from the sliding assembly H, and the return spring 95 pushes the sliding assembly H back to its original position. Meanwhile, the sliding assembly H rotates about the base assembly G. The annular neck portion 529 of the control rod 52 moves downward (to disengage from the pressure relief steel ball 531 again), the
10 pressure relief steel ball 531 pushes the pin 532 and the spring 533 backward, so that the pressure relief oil space B disappears. Meanwhile, the control groove 51 of the control valve assembly 50 changes with the downward movement of the control rod 52, and the first and second oil rings 522 and 523 are aligned with the main passage 54 and the auxiliary passage 55 again. Therefore, the oil W flows into the oil
15 chamber 21 again (the pressure thereof increases again), and the brake lining assembly 70 instantly clamps the brake disc 11 again. Such instant clamping and instant relief actions will occur repeatedly, preventing the brake disc from being clamped too tight (antilock effect).

It is to be noted that a plurality of anti-collision structures are provided on
20 the sliding assembly H and opposite the base assembly G, wear-resistance structures are arranged at the positions where the friction frequently occurs, and the present invention is also provided with a plurality of position adjustment structures.

Referring then to Figs. 6 and 7, aiming at the safety operation, the present

invention is particularly provided with the safety rod 90, the safety spring 92 and the support bracket 93. If the return spring 95 is broken (as shown in Fig. 6), the support bracket 93 will not be pushed by the return spring 95 anymore but will be subjected to the pushing force of the safety spring 92. At this moment, the support bracket 93 will be deformed or will move downward, and the safety rod 90 will lose its supporting force since it is riveted to the support bracket 93. As a result, the end of the safety rod 90 doesn't seal the safety oil passage 43 of the second arc-shaped track 40 anymore. Meanwhile, the oil W from the oil feeding hole 551 flows into the safety oil passage 43 via the second oil ring 523 of the control valve assembly 50, and constantly increases the pressure of the oil chamber 21. Although the control rod 52 cooperates with the pressure relief steel ball 531 to produce a pressure relief oil space B, the oil from the safety oil passage 43 can still enable the brake lining assembly 70 to keep firmly pressing against the brake disc 11. Therefore, the emergency brake effect (only the antilock effect is lost) can still be ensured even if the return spring 95 is broken. Furthermore, if the return spring 95 fatigues, the safety rod 90, the safety spring 92 and the support bracket 93 can still produce the effect of emergency brake.

Referring to Figs. 8 and 9, which show a second embodiment. In this embodiment, there are two sets of oil chambers 21, pistons 22 and steel-ball positioning discs 25, and each set includes the oil seals 23, 23a, 24, 24a, steel-ball positioning discs 25, 25a, a plurality of steel balls 26, 26a, and pistons 22, 22a slideably sealed in two oil chambers 21, 21a. The two oil chambers 21 are in communication with each other via a main passage 54. An exhaust valve 27 is

arranged beside the oil chamber 21, and a safety oil passage 43 is formed beside the oil chamber 21a. By using the double pressing devices 20, the resultant braking force will be more strong, and the antilock effect will be better.

Fig. 10 shows a third embodiment of the present invention, this embodiment is additionally provided with a main cylinder C3 and an elastic oil-storage cylinder C31. The seat C1 is installed on the wheel carrier 10 and serves to cooperate with the moveable base assembly C2. The status of the hydraulic disc brake device before braking action is shown in Figs. 11-14, the status of the hydraulic disc brake device during braking action is shown in Figs. 15-18, and the status of the hydraulic disc brake device during antilock action is shown in Figs. 19-21.

The seat C1 is fixed onto the wheel carrier 10, a L-shaped stop board C11 is riveted to either side of the seat C1, and a space is defined between the two L-shaped stop boards C11. The two L-shaped stop boards C11 are located in the arc-shaped route of the wheel axis. Two sliding members C12 with opening facing each other are disposed in the arc-shaped route of the wheel axis, and each of the sliding members C12 is a structure with one end closed and with an interior receiving space.

The base assembly C2 includes a pressing device C21, a first arc-shaped track C22, a second arc-shaped track C23, a control valve assembly C24, a spring assembly C25, the main cylinder C3 and the elastic oil-storage cylinder C31.

The spring assembly C25 is confined in the first arc-shaped track C22 by the sliding assembly C12, and includes a safety rod, two seal rings, a safety spring, a support bracket, a washer and a return spring. One end of the return spring cooperating with the washer and the support bracket is pressed against the bottom

edge of the first arc-shaped track, and another end of the return spring is pressed against the sliding members C12 of the seat C1. The safety spring is restricted in the support bracket and the return spring, and the safety rod is riveted to the support bracket.

5 The pressing device C21 includes a piston C211, and a plurality of oil seals C212. Since the pressing device C21 moves along with the base assembly C2 and the braking lining assembly C26, it doesn't need the steel balls and the steel-ball positioning disc, and it can use the conventional pressing device to cooperate with the brake lining assembly C26, and the brake lining assembly C26 is pressed to
10 clamp the brake disc 11.

 The first and second arc-shaped tracks C22 and C23 are also provided with the wear-resistance covers C221, C231, the sling members C12 are slideably installed on the first and second arc-shaped tracks C22 and C23. An antic-collision cushion C232 is disposed at the end of the second arc-shaped track C23, and the first
15 arc-shaped track C22 is interiorly formed with safety oil passage. The end of the safety rod of the spring assembly C25 is pushed by the return spring to close the safety oil passage.

 The assembly, function and effect of the control valve assembly C24 are similar to the previous embodiment, and the only difference is that the position and
20 the structure of the oil route are changed appropriately.

 It is to be noted that the main cylinder C3 and the elastic oil-storage cylinder C31 are installed on the base assembly C2 directly. The main cylinder C3 utilizes a steel cord C32 to drive the main piston C33, so as to push the oil into the

oil chamber. A pushing spring C34, an O-shaped ring C36, and a piston C35 are sealed in the elastic oil-storage cylinder C31 by a cover C37. The pushing spring C34 pushes the piston C35 to move, so as to push the oil into the main cylinder C3, and the oil pressure of the main cylinder C3 is directly connected to the control valve
5 assembly C24.

In this embodiment, the seat C1 is mounted on the wheel carrier 10.

The main cylinder can also be mounted on the handlebar.

While we have shown and described various embodiments in accordance with the present invention, it is clear to those skilled in the art that further
10 embodiments may be made without departing from the scope of the present invention.